COAL TRANSPORTATION INFRASTRUCTURE IN INDIA

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1.0. Introduction

Endowed with large reserves of coal, India is making plans to increase the dominant share that coal already has in the country's consumption of commercial energy. The coal policy is shaped by the Ministry of Energy in consultations with the Planning Commission, which is responsible for the formulation of the five year plans. The policies have to be approved by the Central Cabinet of Ministers. The State Governments have no direct role except for their representation on the National Development Council, which determines the priorities of sectoral development and resource allocations.

There is no comprehensive legislation related to all sources of energy. Each sub-sector is governed by a separate set of regulations. Coal usage and production are regulated by the Essential Commodities Act (Colliery Control Order) and Mineral Commission Rules. Until 1967, the distribution of coal was regulated by the Coal Controller under the Colliery Control Order (1945). Now the distribution of only coking coal is under statutory control. The government of the coal policy. The current policies are guided by the recommendations of the Fuel Policy Committee (1974) and the Working Group on Energy Policy (1978). Prior to this, decisions had been made in an ad hoc fashion since 1947. There have been no environmental considerations in the coal policy. these are appraised, regulated and monitored separately by the Department of Environment, Government of India. Similar agencies are being set up in the State Governments.

The entire coal industry was nationalized in 1973 and incorporated as Coal India Limited. A new Department of Coal was formed under the Ministry of Energy out of some sections of the Ministry of Steel and Mines which now has control of only non-coal mining. There is no rolee left for private industry in the production of coal but it is involved in coal transportation by road and in coal based industries.

2.0. Coal Resources And Utilisation

2.1. Resources And Quality

India's coal resources are well in excess of 100 billion tonnes, and the proved reserves are 28.2 billion tonnes (Ministry of Energy, 1981). as seen from Table 1, only

a small fraction of proved reserves is in the form of lignite, with the remainder of the reserves having medium-to-high heat content.

Table 1: Coal Resources And Reserves In India (In Million Tonnes)

Type Of Coal	Resources In Place	Proved Results
Prime Coking	6,024	5,479
Lower Quality Coking	17,367	5,251
Non-Coking Coal	87,637	15,519
Tertiary Coal	850	82
Lignite	2,100	1,870
TOTAL	113,978*	28,201

Source: Government of India, Ministry of Energy, Department of Coal (1981). Report 1980-81. New Delhi.

* Latest assessment shows the figure as 129.000 (approximately) - the increase is by about 16 billion tonnes in Bituminous coal resources - as on 1.2.1983.

Most of the coal reserves are in the northeastern part of the country, in the states of Bihar and West Bengal (figure 1). Since the demand for coal is spread all over the country, some coal has to be transported over long distances.
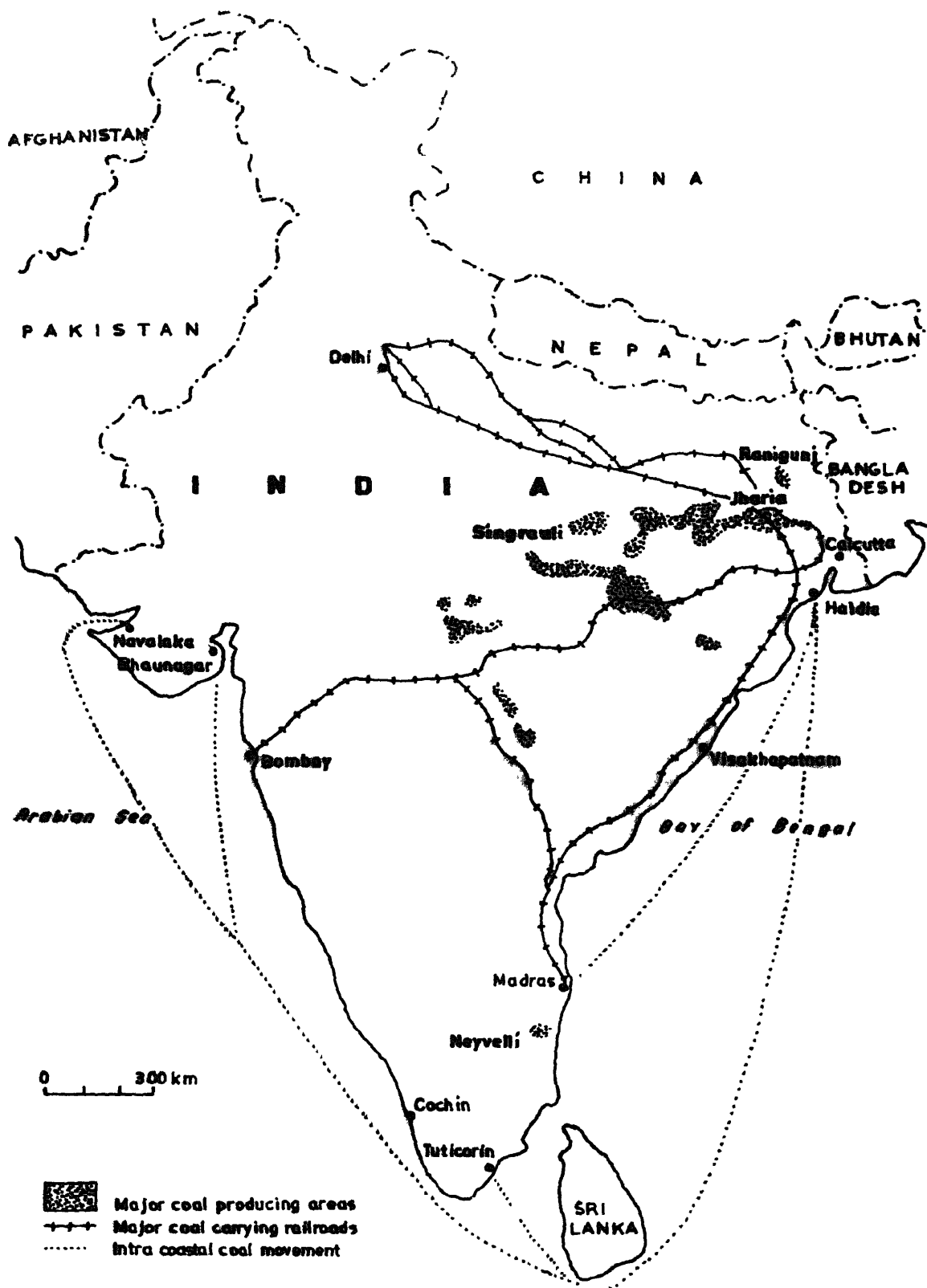
Fig: 1. India: Coal production and transportation Infrastructure.

Most of coal mines in India are deep mines, but the proportion of surface-mined coal is increasing rapidly. During 1975-76, about 25% of coal production came from surface mines. This percentage is expected to increase to 40% of the total by 1983-84 (Ministry of Energy, 1980).

The sulfur content of Indian coals is usually low (about 0.5%), but the ash content is very high, about 25-30% on average, but exceeding 50% at times.

Almost all of the coal produced in India has medium-to-high heat content. The exception is the Neyveli Lignite corporation, Tamil Nadu State, where the lignite has a heat content of 2,400 kilo calories per kilogram, about 50-60% moisture, and an ash content as low as 3-6%. Lignite mining on a much smaller scale is also being undertaken in Gujarat State, and some deposits have been found in Rajasthan.

2.2. Current Production And Use

India produced 114 million tonnes of coal during 1980-81, almost all of which was used within the country. The use of coal by individual sectors is given in Table 2.

Table 2: Consumption of Coal in India During 1980-81

Consuming Sector	Amount (million tonnes)
Power	36.7
Cement	4.8
Railways	11.8
Steel	22.4
All Other Uses	33.5
Total	109.2

Source: Ministry of Energy, Department of Coal (1982). Annual Report 1981-82, Government of India Press, New Delhi.

As seen in Table 2, over a third of the coal produced is used for electric power generation. Coal-fired thermal power stations now account for 62% of the total electric power generated in the country.

The major coal producing areas in the country, as well as the coal transportation system, are shown in figure 1.

2.3. Coal Exports and Imports

India has been a small importer and exporter of coal. About 110,000 tonnes of coal were exported during 1980-81, and some metallurgical coal was imported from Australia. Coal exports are not expected to increase beyond 500,000 tonnes per year by the end of the century, as shown in Table 3.

Table 3: Projected Use of Coal in India (Million Tonnes)

Consuming Sector	Projections By The Planning Commission (1980)		
	1987-88	1992-93	2000-01
Power	62.5	85.7	135.7
Cement	10.2*	13.7*	21.4*
Railways	11.0	7.8	3.4
Steel	49.0	72.0	115.3
Export	0.5	0.5	0.5
All Other Uses	60.5	79.4	127.9
Total	203.3	273.5	427.2
Projections by Pachauri (1982)	179.9	225.7	300.1

* Assumed at 5% of total demand.

Sources: Adapted from: Planning Commission (1980). Report of the Working Group on Energy Policy, Govt. of India Press, New Delhi, Pachauri, R.K. (1982). "Future Energy Consumption and Supply in India" in Future Energy Consumption and Supply in India, etc. by Dunkerley et al. Resources for the Future, Washington, D.C.

2.4. Future Production And Use

Coal use is officially projected to increase between four and five fold by the end of this century. These projections were made by the Planning Commission through its Working Group on energy Policy (1980). Two sets of forecasts were produced. The 'reference level' forecasts used trend, regression and end-use analysis and assumed no major changes in the past pattern of consumption. The 'optimal level' forecasts involved normative considerations and a consensus of subjective judgements. The former predicts a five-fold increase in the total requirements of coal by the year 2000, but is generally discounted by policy makers as being unrealistic. The latter predicts a four-fould increase. This too is thought implausible by some (e.g. Pachauri, 1982), given the realities of the coal and rail industries, a three-fold increase is considered more likely. Neither of the forecasts based its projections upon a detailed international market analysis, since coal imports and exports are marginal in India. Both projections are given in Table 3.

All the increased requirements are expected to be met by increased domestic production, except that 10-15% of the requirements of coking coal will need to be imported. Export commitments to neighbouring countries are expected to amount to only 0.4 million tonnes, by 1984-85. In the projections in Table 3, exports are assumed to remain constant at half a million tonnes annually. Similarly, the growth of the cement industry has been assumed to parallel the growth of coal production, and consume one-twentieth of that production. The share of coal consumption for power generation is likely to be 37% according to the 'optimal level' forecast, and 41% according to the 'reference level' forecast.

2.5. Research On Coal Policy

The planned rapid growth of the coal industry is to be accompanied by a number of research and development programs. On coal utilization, a definite policy decision has been taken to use only "inferior" coals in all power stations. Inferior coals are defined in India as those having gross calorific values between 2500 and 5000 kcal/kg. Consequently, Indian utilities have to do with perhaps the worst grade of coal in the world. Research is on to introduce boilers capable of using still inferior coals containing about 70% ash (and therefore a calorific value of less than 1600 kcal/kg) for power generation (as distinct from mere steam raising). For the purpose of pricing, however, incentive for high ash coal usage has been provided by

evolving a formula* for calculating the useful heat value so that the user is compensated for the extra cost incurred on the special equipment for burning coal and handling the extra ash.

Simultaneously, the gasification of coal for piped supply of town gas and the pipeline transportation of coal are under study. Also, wherever pithead consumption is not considered feasible, a begining is likely to be made shortly with alternative modes of movement of coal, including road-river-coastal shipment.

In the metallurgical coal sector, beneficiation techniques using processes of oil agglomeration and chemical demineralization of coal are being developed by the Central Fuel Research Institute.

3.0. Infrastructure for Transporting Coal

3.1. General

In India, coal is moved by rail, trucks, belts, ropeways and coastal shipping. Of these, rail and road account for about 95 of the movement. Railways are by far the most important carriers, accounting for over two-thirds of the coal transported. About 1.5% moves by ships in addition to movement by rail. Table 4 shows the trends in coal despatches between 1979 and 1982.

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* Useful Heat Value = 8900 - 138 (A+M) where
A = % Ash content
M = % Moisture content

Table 4: Percent dispatch of coal by various means

Means	Year					
	1976-77	1977-78	1978-79	1979-80	1980-81	1981-82
Rail*	80.3	77.8	74.2	68.8	65.8	68.3
Road	15.7	18.6	21.5	26.7	28.9	26.6
Ropeway	1.6	1.5	1.7	1.6	2.1	2.0
Belt	2.4	2.1	2.6	2.9	3.2	3.1
Total in million tonnes	88.0	92.9	90.04	93.9	99.6	111.1

* About 2 % moves by captive wagons and another 1.5% by ships in addition to moving by rail.

Sources: Coal India Ltd., and SCCL, Hyderabad.

In general, the transportation system is able to move the coal currently demanded. But it is not certain that it moves by the most efficient means. It is felt that the energy content of the diesel oil used for road transportation of coal (up to half of which may be ash), may be more than the energy content of the coal being transported. The Manuguru coal fields are not connected as yet by a rail link, and all its output moves by road. The railway system is being progressively geared to carry more and more coal as is evident from the past increases in coal freight. Even though future installations of large pithead power plants will have captive unit trains, the anticipated rate of growth of demand for coal exceeds the projected capacity of the railways to handle that coal. Consequently, road transport will continue to play an important role. However, roads and bridges have not been designed for the increased loads and traffic, and will need to be upgraded.

Based on the coal policy, the government has initiated a number of actions related to the transportation system since the early seventies. Some of these are:

* Facilities using oil and gas are encouraged to switch to coal, except where there are no alternative uses for the gas.

* Bulk movement of coal has been increased through

[illegible] trains and reduced [illegible] loading points.

* Coal dumps have been created all over the country to avoid piece-meal movement to small consumers (Ministry of Energy, 1982).

* There is a deliberate policy to phase-out the use of coal in the highly inefficient steam locomotives. electric traction and diesel locomotives are preferred for bulk movement of commodities.

* By-passes are being thought of for congested railwway routes (Planning Commission, 1980). The government has also commissioned several studies to look at the technical and economic feasibility of alternative means of transporting coal by barges and slurry pipelines.

Other than road transportation, which is in the private sector, all other transportation modes and their construction including road construction, are in the government sector. As far as jurisdictions are concerned, roads and trucking are under the Ministry of Shipping and Transport, whereas there is a separate ministry for the Railways. Belts and ropeways are controlled by the respective ministries controlling the consumer industry that uses these modes for the supply of coal. It is obligatory for Indian flagships and conference (private) vessels to be involved in the movement of coal unless, of course, the ships do not call on ports receiving the coal.

3.2. Rail

Over 75 million tonnes, or over two-thirds of the coal, produced moves by rail. The major rail routes for the movement of coal are from the coal fields concentrated in eastern and central India to demand centres in the northern and western regions of the country (see figure 1). The average capacity of the rail cars is 56 tonnes. Broad gauge lines 2.0-2.4 cm (5-6) of weight 60-75 kg/m are used. Some of the coal also moves on metre gauge lines.

A whole gamut of loading and unloading systems are in use from manual to high speed mechanical loaders (2000 tonnes/hr) and tipplers. Hopper cars are used only by the steel industry. A separate estimate of the number in use is not readily available.

All rail cars and locomotives are manufactured

domestically. The locomotives are built at the Chittaranjan Locomotive Works, and at the Diesel Locomotive Works in Varanasi. Wagons are manufactured both in the public as well as private sectors. Maintenance facilities seem to be adequate and are spread all over the country. Coal-fire locomotives are not used for coal haulage.

About three-tenths of the total freight movement (tonne-kms) by the railways is accounted for by coal (Figure 2).

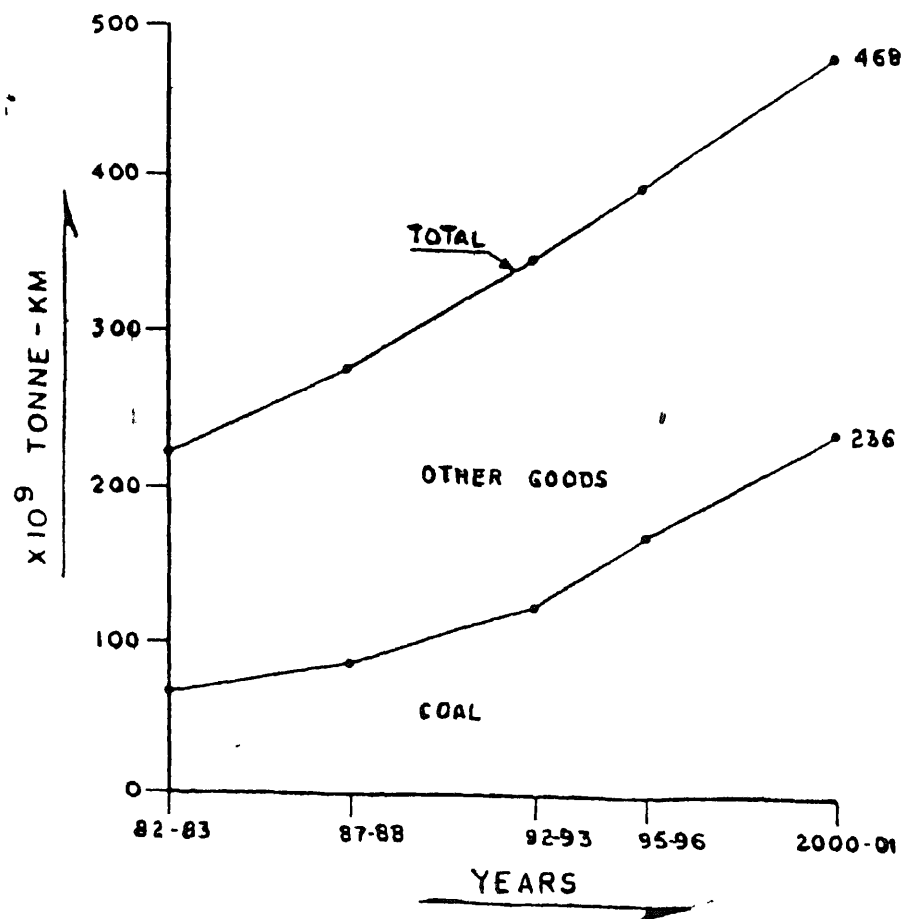



Fig: 2 Railways total originating freight, traffic.

Costs, once again, depend on the distance and type of traction, and are lower for block loads than individual wagon loads ([illegible]).

TPSs NORTHERN LINE	1995-96 DEMAND +(MTPA)	STATES
1 TANDA	1 48	UP
2 UNCHAHAR	2 70	"
3 PANKI	0 97	"
4 PARICHHA	2 09	"
5 HARDUAGANJ	2·00	"
6 BADARPUR	2·36	DELHI
7 INDRAPRASTHA	1·06	"
8 RAJGHAT	0·51	"
9 NCR	2 70	"
10 FARIDABAD	0 73	HARYANA
11 PANIPAT	2·16	"
12 YAMUNANAGAR	2·70	"
13 RUPNAGAR	2·70	PUNJAB
14 BHATINDA	2 16	"
	26·32	
WESTERN LINE		
15 GANDHINAGAR	2·16	GUJARAT
16 AHMEDABAD	0 86	"
17 WANAKBORI	4·04	"
18 UKAI	2·77	"
19 BHUSAWAL	1·58	MAHARASHTRA
20 NASIK	2·97	"
21 TROMBAY	3 62	"
	18·00	

+ MILLION TONNES PER ANNUM OF WASHED COAL.

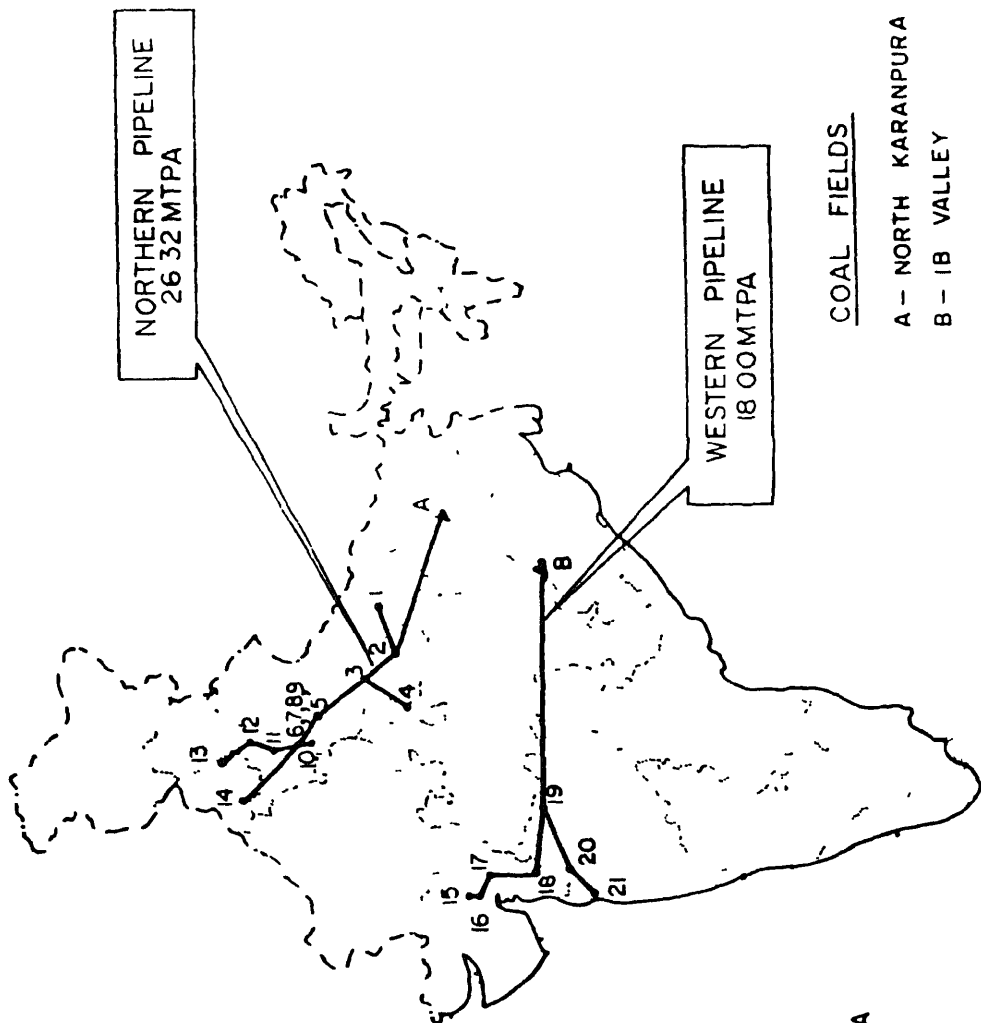



FIGURE- 5·2·3
PROPOSED PIPELINE ALIGNMENTS

Each additional kilometer with diesel locomotives, costs about six paise per tonne, and between three and five paise per tonne with electric locomotives (10 paise = 1 U.S. cent). Wagon loads are about a paise per tonne costlier (1976-77 prices). There are efforts to further bring down the costs of transport by using longer trains (2000 to 3000 tonnes per rake) and by increased use of electric traction.

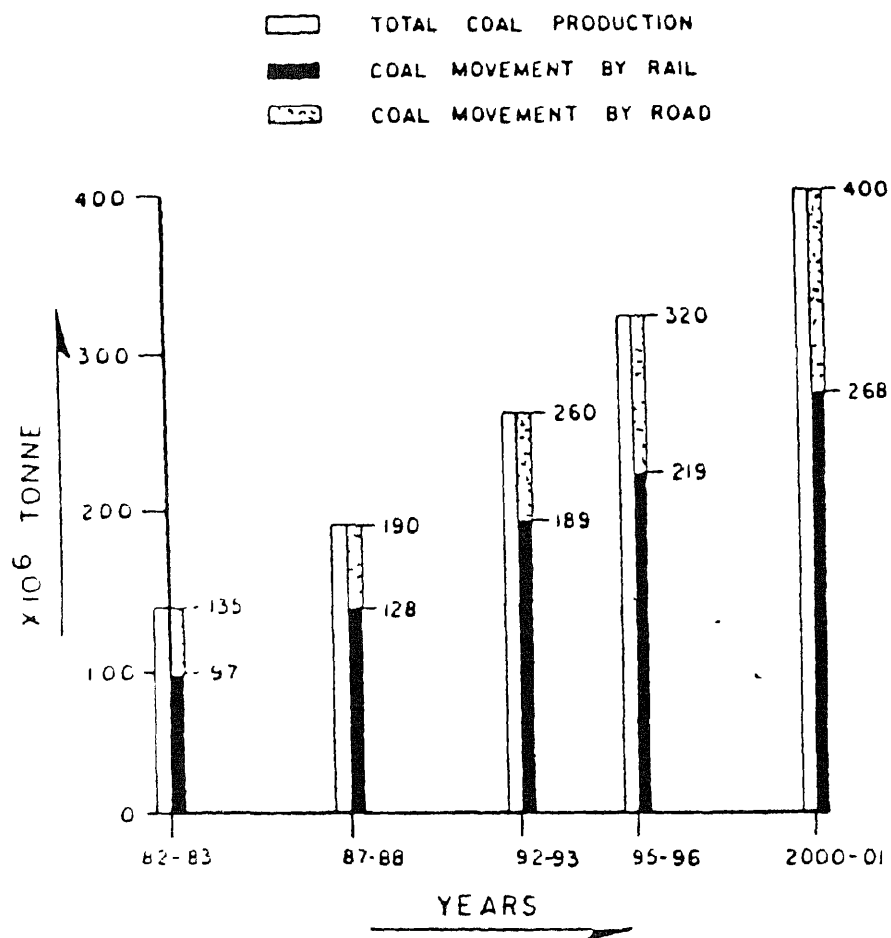
The Railway Board of the Government of India is the agency responsible for the planning and development of new rail lines. All the existing rail routes in India are multi-traffic, and bottle-necks in coal transport have been endemic especially in regions where heavy coal traffic competes with passenger and other freight traffic. By-passes and alternate routes are needed in Mughalsarai, and in the Singrauli-Katni, Asansol-Jhajha, Barauni-Lucknow sectors. Projects are underway to upgrade the truck routes and junctions all over India. This involves doubling and trebling of tracks, making tracks capable of withstanding increased speeds and installating electronic controls. Rail cars of 100 tonne capacity, capable of being loaded at 5600 tonnes/hr, are being introduced. In the future, all new operating rail systems will have to obtain clearance from the Department of Environment.

3.3. Roads

In 1981-82 trucks carried 26.6% of all coal, most of it over public roads (Table 4). Trucks also carried a similar amount (about 12 million tonnes in 1977-78) over internal colliery roads from pitheads to railway sidings, a distance of 3-5 kms. But, these are not counted as movements by road in the published statistics. Coal India owns and maintains about 480 kms of metalled roads; 1260 kms of feeder and approach roads which are owned by state and local governments. The conditions of these roads is stated to be extremely poor.

The truck sizes vary between 10 and 20 tonnes. The average distance travelled is about 400 km and the maximum around 1600 kms. The costs per km depend on the distance carried. The increase in cost for distances over 300 kms is about 9 paise per tonne per km (1976-77 prices). The comparative costs of coal transportation by rail and road are shown in Figure 3.

Trucks are used to move coal in all "non-priority sectors" i.e., those other than power, steel, cement and fertilizers. They are also used in coalfields that are either not yet connected with railway lines or are faced with shortage of wagons.

The current and projected amounts of coal moved by rail and road in India are shown in Figure 4.

As mentioned earlier, the Ministry of Shipping and Transport is responsible for road planning and construction of national highways. The State highways come under the purview of the State Public Works Department. In future, environmental assessments will be required. Some new feeder roads are being constructed to remove junction restrictions, otherwise the upgradation of highways is marginal. Some roads have been built solely for coal traffic in the Jharia and karanpura Coalfields, but these invariably get used by non-coal carrying traffic because of shortage of roads suitable for high speed traffic. The problems anticipated with upgrading and new projects are diversion of roads, displacement of populations, and some amount of social disruption due to construction of truckers' inns near villages.

3.4. Waterways

Inland water transport, though cheap and efficient is not being currently used to transport coal because of a number of problems inherent in this mode. It is slow, and most Indian waterways are not navigable throughout the year because of withdrawal of large suplies of water for irrigation. The cost advantages over rail and road disappear when transhipments are involved so that it would be a preferred method only when the origin and destinations are on waterfronts.

During the periods 1959-64 and 1971-74 coal dust for use in brick kilns was moved by barges on the Ganga between Patna and Ballia. Since the construction of bridge, they have been displaced by trucks.

Consulting Engineering Services (India) has conducted a pre-feasibility study for the transport of coal between Hoshangabad (MP) and points in Gujarat on the River Narmada. Since the internal rate of return was estimated to be around one percent, the proposal is not evoking much interest. What looks more promising is a proposal to move coal using inland water transport between Farakka and Allahabad. the feasibility study conducted by the same company recommends coal to be loaded at Rajmahal and delivered upstream to Bhagalpur, Mokameh, Patna and Chapra. It is projected that this route could handle 1.6 million tonnes in 1991, and grow to 2.5 million tonnes by 2006.

3.5. Slurry Pipelines

There are no existing slurry pipelines in operation. Gujarat State Electricity Board was the first agency in India to ask Engineers India Ltd. (EIL), to investigate the feasibility of using coal slurry pipelines to transport 10 million tonnes of coal annually from Singrauli to power stations at Wanakbori, Ukai and Narmada. Because the economies were thought to be favourable as compared both to railway transportation or pithead generation and extra high voltage transmission, the Planning Commission in 1980 commissioned EIL to look at the technical and economic feasibility of two pipelines. these would carry beneficiated coal from the east to power stations in northern and western India. The Northern pipeline is to originate in North Karanpura (Bihar) and to serve 14 power stations in Uttar Pradesh, Delhi, Haryana and Punjab. The Western pipeline will link Ib valley (Orissa) to seven stations in Gujarat and Maharashtra (Figure 3).

This pipeline will be 1879 kms long, will have a diameter tapering from 85 cms to 30 cms and carry annually 18 million tonnes of coal. The northern one, will, on the other hand, be 2024 kms long, have a diameter between 25 and 100 cms and carry 26 million tonnes of coal.

These pipelines are at least a decade away. The construction of a short pipeline as a test facility is expected to take about five years. In addition it remains to be seen, if the originating states will allow huge transfers of their water resources along with the coal. Inter-state water disputes have been frequent in the past.

3.6. Conveyor Systems

Ropeways and beltways account for about two and three percent of the coal movement respectively. Ropeways are good for short hauls (less than 50 kms) in difficult terrain where other means of transport are not available. In 1965-66 there were approximately 145 kms of ropeways with an installed capacity of 2900 tonnes per hour. There are now 18 ropeways in operation, mostly in the coalfield regions of West Bengal and Bihar, covering distances upto 20 kms and with capacities of 200 tonnes/hr. Gradual future growth is expected in the Jharia and Raniganj coalfields where surface modes of transport are becoming increasingly congested.

Some of the power plants have their own captive ropeway and belt systems. Data on beltways is hard to come by. The National Transport Policy Committee has recommended that coal depot yards be suitably remodelled so that in future coal raisings could be transported not by pilot trains, but by a system of conveyor belts for mechanical loadings on to heavy unit trains.

3.7. Ports and Harbours

Coal movement by sea presently comprises over 60% of total coastal dry cargo traffic and is likely to remain the most important. All of the coal that moves by ship also moves by rail. The ports that handle coal are Calcutta, Haldia, Madras, Vishakhapatnam, Paradeep and Tuticorin (see Figure 1). The last three handle coke as well. Calcutta, Haldia and Vishakhapatnam send out coal whereas the others receive it. Bombay and Cochin were also involved in receiving coal in the past. Coking coal is imported into the country through Vishakhapatnam. Haldia is a satellite port of Calcutta. so ships partially loaded at Calcutta are sometimes topped off at Haldia.

The annual capacity for handling coal is 1 million tonnes at Calcutta, 2 million at Haldia and 2.25 million at Tuticorin. All the other ports handle coal on a general cargo basis. The total average estimated capacity is shown in Table 5 along with the coal handled. There is double counting in the coal statistics because both loading and unloading operations aare counted. Coastal movement of coal is expected to grow to 7 million tonnes annually in the period 1987-1983 as compared to 3.15 million tonnes at present.

Table 5: Coal movements at major ports (In million tonnes)

Port	Estimated Avg Total Capacity (all cargo)	Coal Movements				
		1950-51	1965-66	1977-78	1978-79	1982
Calcutta	19.26	2.10	1.37	1.04	0.84	0.34
Haldia	-	-	-	-	-	1.08
Madras	15.00	0.40	0.39	0.08	0.06	0.08
Paradeep	3.85	-	-	0.04	0.03	0.17
Tuticorin	5.63	-	-	0.02	0.13	1.05
Vishakha-patnam	12.98	-	-	-	-	0.43
Bombay	20.50	0.10	-	-	-	-
Cochin	5.45	0.10	0.19	0.14	0.11	-
Total		2.70	1.95	1.32	1.17	3.15

Sources: Planning Commission, Government of india and Ministry of Shipping and Transport.

The coal is moved to, and away, from the ports by rail with loading and unloading done mechanically. There is a coal dump at haldia which is plagued by inadequate internal transport. All major Indian ports are multipurpose ports and all accommodate ships with a draft of 9.76m. The ships that move coal are 30,000 to 35,000 DWT. Port operations are sometimes hampered by cyclonic weather. During such times the ships are asked to leave berths. There are no special laws that apply to environmental problems like fugitive dust, etc. Paradeep, Vishakhapatnam, Haldia and Tuticorin are expected to enlarge and upgrade coal handling facilities. The only new major port that is being constructed is Nhava Sheva, near Bombay. It will handle mostly bulk cargo and containers. It is not dedicated to coal movement or associated with a power plant.

Though coastal shipping is generally accepted as the most energy efficient and cheapest mode of transport for bulk commodities over long distances, its share in freight movement has been declining in India. This is because the detour around Sri Lanka makes the distances travelled much longer. Coupled with two loading and unloading operations, this makes coastal shipping as expensive if not more than rail. The decline in coastal traffic has occurred in spite of a government subsidy equivalent to difference in freight cost of rail-sea-rail route and all rail route. The subsidy amounted to 60 million rupees in 1975-76. The monies are raised through an excise duty under Coal Mines conservation and Development Rules which were originally intended for conservation and welfare purposes.

In this section, an overview of the coal transportation in the country has been presented. There is considerable uncertainty that the transportation system can be geared for a quadrupling of capacity before the end of the century. In conclusion, the exhortation of the National Transport Policy Committee may be cited:

> "As development of capacity in coal depot yards, conveyor system, alternative routes, etc. takes several years, planning should be undertaken and investment made early enough so that coal traffic requirements do not outstrip capacity. The consequences of any neglect in this direction are too serious, and recent experience in regard to coal movement only reaffirms our view."
> (Planning Commission, 1980).

4.0. Environmental considerations in transporting coal

4.1. Environmental policies and legislation

The first formal recognition of the need for environmental protection came with the formation of the National Committee on Environmental Planning and Coordination by the Government of India in 1972. In 1977, the Constitution of India was amended to include two articles explicitly dealing with the environment.

> "The State shall endeavour to protect and improve the environment and to safeguard the forests and wildlife of the country". (Article 48-A).
>
> "It shall be the duty of every citizen of India to protect and improve the national environment including forests, lakes, rivers, and wildlife and to have compassion for living creatures." (Article 51-A-g).

Legislation dealing with air and water pollution have also been enacted by the Parliament. These are the Water (Prevention and Control of Pollution) Act of 1974 and the Air (Prevention and Control of Pollution) Act of 1981. Neither apply specifically to the coal industry but they empower Pollution Control Boards that can regulate all major industries.

Each industrial project needs clearance from the Department of Environment, which was established in 1981. In addition, the World Bank, which has funded certain railway projects, has required that environmental assessment be carried out before sanction. the small-scale industries are cleared by state governments. For the planning of coal transportation projects, the respective ministries and the Planning Commission are responsible. Generally, there is little co-ordination between those involved in the supply, trnasportation and use of coal except at the stage of sanctioning of the main project. The Clean Water and Air Laws are applicable to coal transportation projects as well. Noise is not currently regulated.

4.2. Present Environmental Concerns

As the coal producing and the major coal consuming industries are in the nationalized sector, minor conflicts among them do not remain unresolved for long.

Environmental consciousness is of recent origin whereas the use of coal goes back decades. There are bound to be trade-offs in the simultaneous implementation of the coal and environment policies, especially since coal use is expected to triple or quadruple by the end of this century. Some of the problems associated with the increased use of coal, e.g. safety of miners, water runoff from mines and coal preparation plants, air quality deterioration due to combustion, etc. are discussed in Siddiqi (1981) and in Ahuja (1983). The environmental problems caused by the coal transportation system are thought to be minor as compared to the problems in the other phases of the fuel cycle. However, the increase in traffic density over the public road system due to increased transport of coal by trucks is receiving attention.

Air pollution impacts result from coal transport whenever diesel locomotives are used, which is often because large portions of rail lines remain unelectrified. Traffic disruption at railway crossings is a very common occurrence in the country. Coal dust and noise are problems near the tracks but no special laws have been framed for either of these. The general standards apply.

The incorporaation of environmental considerations in the planning and construction of road systems have been inadequate in the past. The transport of coal inevitably causes damage to the public roads because the increased loads and traffic density are beyond the designed capacity.

Other forms of road transport, especially on the highways, get eased out. Where the roads are tarmacadamized and not yet damaged, the road dust problem is not severe. In other places, fugitive dust problems can be serious though localized. The scrubbing effect of a long spell of the monsoon, periodically, helps reduce the dust nuisance. Noise and accident hazards, generic to all truck transportation, are also serious but have not received sufficient attention.

The major environmental problems that have been identified with respect to coal slurry pipelines, concern water requirements and the two ends of the pipeline, i.e. at the coal preparation plants and at the slurry dewatering plants. The problems at the preparation plants will come from dust and noise during crushing and from the waste water from coal washeries. At the dewatering facility, the effluent is likely to

contain coal leachates (Bertram, 1980, Planning commission, 1983) and the dewatered coal being of fine size will require protection against rain, wind, oxidation and require protection against rain, wind, oxidation and self-ignition.

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